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P01/7700 0.00-0220462.6

Request for grant of a patent

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Cardiff Road
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1. Your reference 24/PP32649GB

2. Patent application number *(The Patent Office will fill in this part)* 0220462.6 03 SEP 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

PIPELINE POLYMERS LIMITED
CROWN HOUSE
28 WINCHESTER ROAD, ROMSEY
HAMPSHIRE, SO51 8AA, U.K.

Patents ADP number *(if you know it)* 8458432001

If the applicant is a corporate body, give the country/state of its incorporation: UNITED KINGDOM

4. Title of the invention

LINING OF PIPES

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

MATHISEN & MACARA
The Coach House
6-8 Swakeleys Road
Ickenham, Uxbridge
UB10 8BZ

Patents ADP number *(if you know it)* ~~1594001~~ 8188245001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

Patents Form 1/77

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Continuation sheets of this form	
Description	11
Claim *(s)*	4
Abstract	1
Drawing *(s)*	3 + 3

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature: Mathisen & Macara — Date: 3 SEPTEMBER 2002

12. Name and daytime telephone number of person to contact in the United Kingdom: MARK C FOSTER — 01895 678331

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FV1:020903

UNITED KINGDOM PATENT APPLICATION

APPLICANTS: PIPELINE POLYMERS LIMITED

CASE CODE: "Gap Spanning" – PP32649GB

FORMAL TITLE: LINING OF PIPES

APPLICATION NO:

FILED:

PRIORITY CLAIMED: NIL

MATHISEN & MACARA
6-8 Swakeleys Road
Ickenham, Uxbridge
England, UB10 8BZ

Agents for the Applicants

LINING OF PIPES

The present invention relates to a method of lining a pipe, to a method of forming a pipe comprising a plurality of coupled sections and to apparatus for lining a pipe.

Pipelines for transporting fluids such as water, oil, gas and sewage are well known. Typically, such pipelines extend for a long distance and comprise a plurality of discrete pipe sections that are coupled together. Figure 1 shows a prior art arrangement where a first pipe section 1 and second pipe section 3 are coupled together by a spigot and socket joint 5. To prevent egress of fluid from the joint between the two pipe sections 1 and 3, an annular seal 7 is provided which seals the interior surface of the enlarged section 9 of the second pipe section 3 against the exterior surface of the first pipe section 1.

Typically, such pipelines are buried underground. Over a period of time fluid leaks can develop. For example, the pipeline may crack (due to ground movements) or may corrode. When the pipeline comprises a plurality of coupled sections, fluid leaks at the spigot and socket couplings 5 can develop, due to ground movement and deterioration of the annular seals 7. It is known to line pipelines with a sealing material in order to prevent fluid leakage. A lining may be in the form of a pre-formed flexible membrane which is passed along the interior of the pipeline and fixed in position, or may be

applied by spraying lining material onto the interior surface of the pipeline. Such linings may be formed when the pipeline is initially laid, or may be provided after a period of use, when the pipeline itself or the spigot and socket couplings 5 begin to deteriorate.

Figure 2 shows a view of part of the pipeline of Figure 1 to which a lining 11 has been applied by a spraying method. The lining 11 has not performed the desired function of providing a fluid-tight path within the interior of the pipeline because the material of the lining 11 has been unable to bridge the gap 13 between the first and section pipe sections 1 and 3. When such a situation arises, the lining process has been unsuccessful and any fluid leakage that was occurring at the spigot and socket joint 5 prior to lining the pipeline will continue.

The spigot and socket type joint is commonly employed for forming underground pipelines because it provides flexibility for ground movement, angular deflections and allows some expansion and contraction of the sections of the pipeline.

It is also sometimes desired to seal off a redundant fluid passage communicating with the main pipeline. Generally, a conventional lining method will not be able to successfully bridge such a fluid passage, and a lining operation carried out in the conventional manner will therefore fail.

According to an aspect of the present invention, there is provided a method of lining a pipe having at least one gap or discontinuity in the interior surface thereof, the method including applying filling material to the gap or discontinuity, and spraying a lining material over an interior surface of the pipe and the filling material.

The gap or discontinuity may arise as a result of the pipe cracking (particularly in sewer pipes), or may arise as a result of holes in the pipes formed by corrosion (in metal pipes). Additionally, the gap or discontinuity may be a redundant fluid passage or off-take from the main pipe.

According to another aspect of the present invention, there is provided a method of lining a pipe comprising a plurality of coupled sections, the sections being coupled such that a discontinuity in the interior surface of the pipe is formed at the region of the coupling, the method including:

applying a filling compound to the region of the coupling to bridge the discontinuity and present a substantially smooth interior surface for the pipe, and

spraying a lining material over the interior surface of the pipe, including the region of the coupling.

According to a further aspect of the present invention, there is provided a method of forming a pipe, including coupling a plurality of pipe sections, and lining the pipe according to one of the methods defined above.

By providing a filling material to the gap or discontinuity in the pipe a continuous, substantially smooth interior surface of the pipe may be formed. The gap as shown at 13 in Figure 2 is bridged. This allows a subsequently applied lining material to be applied by a spraying method. Because the gap 13 between the pipe section is reduced or eliminated, the spray coated lining will tend to bridge the coupling between the pipe sections (or other gap), thereby providing a fluid-tight conduit within the pipe.

The pipe sections may be coupled by a spigot and socket joint, although it should be understood that the invention is not limited to such a joint arrangement. The invention may be advantageous when applied to the coupling region where two pipe sections join, at which there is anything other than a completely smooth interior surface to the pipeline at the point of transition from one pipe section to another pipe section. The lining material may form a cross-linked molecular structure on the interior surface of the pipe. For example, the lining material may be a flexible polyurea.

Typically, a fluid seal is applied between the pipe sections. Such a fluid seal may be a conventional annular fluid seal as shown at 7 in Figures 1 and 2. The fluid seal will

generally be applied prior to lining a pipeline, and prior to applying the filling material. Indeed, the seal may have been used in the pipe as the only measure for preventing fluid egress for a period of time, after which the seal becomes ineffective, at which time the filler material and spray lining according to the present invention are applied in order to restore integrity of the pipeline. Typically, the seal is located further from the centre of the pipe than the filler material, the filler material being formed at the interior of the pipe and the seal being formed between overlapping portions of adjacent pipe sections when, for example, a spigot and socket coupling is employed.

The present invention also provides apparatus for lining a pipe having at least one gap or discontinuity therein, the apparatus comprising means for applying filling material to the gap or discontinuity, and means for spraying a lining material over an interior surface of the pipe and the filling material.

For a better understanding of the present invention, the method and apparatus for lining a pipeline, and a method for forming a pipeline, will now be described by way of example, with reference to the accompanying drawings, in which:-

Figure 1 shows a cross-section through a conventional pipe comprising two sections coupled by a spigot and socket joint, in accordance with the prior art;

Figure 2 shows a partial view of the pipe of Figure 1 to which a spray coated liner has been applied unsuccessfully, in accordance with the prior art;

Figure 3 shows a pipeline to which a gap spanning material is being applied;

Figure 4 shows a pipeline to which a gap spanning material is being applied by an alternative method;

Figure 5 shows the application of a lining material to the pipe of Figures 3 or 4 by spraying; and

Figure 6 shows the pipe of Figure 5 after completion of formation of the liner.

In the drawings, like elements are generally designated with the same reference numeral.

In the conventional manner, a pipeline is formed by excavating a channel in the ground, in which a plurality of separate pipe sections are laid. Figure 3 shows a first pipe section 1 and a second pipe section 3, although it will be appreciated by those skilled in the art that a pipeline will typically comprise a multiplicity of such sections.

One end of each pipe section 3 has an enlarged diameter portion 9, into which the end of the adjacent pipe section 1 fits. This is the conventional spigot and socket joint. An annular seal 7 is provided between the pipe sections 1 and 3, and it is intended that this seal 7 will provide a fluid-tight joint.

The pipeline thus formed may carry, for example, water, oil, gas or other fluids for consumption by the recipients. The pipeline may alternatively carry sewage.

It may be desired to line the pipeline immediately after the pipeline has been laid in the ground, or after a period of time, when the integrity of the seals 7 have deteriorated so that fluid egress at the coupling 5 between the pipe sections tends to occur.

As discussed in relation to the prior art, a gap or discontinuity 13 exists at the region where the pipe sections 1 and 3 are coupled. In accordance with an aspect of the invention, a gap spanning material 15 is applied to the gap or discontinuity 13. The material 15 forms an interior surface 17 that bridges across the gap or discontinuity 13, providing a relatively smooth interior surface to the pipeline. In Figures 3 and 4, the surface of the material 15 is shown to be slightly proud of the interior surfaces of the pipe sections 1 and 3, where the material 15 is applied to the interior surface of the pipe sections 1 and 3 for a small distance either side of the gap or discontinuity 13.

The material may be applied such that the interior surface 17 is flush with the interior surfaces of the pipe sections 1 and 3, or excess material 15 may be removed to provide a flush surface. Alternatively, the surface 17 may be allowed to remain slightly proud of the interior surfaces of the pipe sections 1 and 3 where this allows the successful subsequent application of a lining material.

As shown in Figure 3, the gap spanning material 15 may be applied by spraying the material at the region where the gap or discontinuity 13 is present. For example, a remote controlled vehicle 19 may enter the pipeline at one end thereof, or at a special location provided for the insertion of such vehicles, after which the vehicle 19 moves to the appropriate locations within the pipeline. A spray head 21 sprays material 15 into the gap or discontinuity 13 to form an annular band of material bridging the gap or discontinuity 13. The material may be supplied remotely through a pipeline 23, or the vehicle 19 may include a sufficient reservoir of material, in which case the pipeline 23 is unnecessary.

Figure 4 shows an alternative method for applying gap spanning material 15 to the gap or discontinuity 13. An inflatable bladder 25 is moved, in a state of deflation, to the desired region of the pipeline, where the gap or discontinuity 13 exists. The bladder 25 is then inflated by applying fluid pressure via conduit 27. Generally, the bladder 25 is formed of flexible material. However, relatively rigid sections 29 are provided for

location either side of the gap or discontinuity 13, defining a gap spanning material 15 application region 31 therebetween. When the bladder 25 is fully inflated, the relatively rigid sections 29 press against the interior surface of the pipeline. Gap spanning material 15 is then applied to the regions 31 by way of conduit 33. The relatively rigid sections 29 prevent the gap spanning material escaping from the region 31. The bladder 25 may remain in position after application of the gap spanning material in order to allow the material to cure, if necessary.

The method of application of gap spanning material 15, as described in relation to Figure 3 or Figure 4, may be applied when the pipeline is "live", i.e. fluid is flowing through the pipeline in substantially the normal manner. If the bladder arrangement of Figure 4 is to be used in a "live" pipeline, a central fluid passage (not shown) is provided through the bladder to allow fluid to pass through the bladder. The bladder 25 will therefore have an annular shape when inflated.

It should be understood that the gap spanning material 15 may be applied by other methods.

After formation of the gap spanning material 15, a lining material 35 is spray-coated onto the interior surfaces of the pipe sections 1 and 3, and also by virtue of its position, on to the interior surface of the gap spanning material 15. The lining material

35 preferably forms a cross-linked molecular structure to provide an internal fluid-tight coating to the interior of the pipeline. The lining material 35 may comprise Copon Hycote 169 SL, which is a flexible polyurea which is specifically formulated to act as an intercalary layer of protection for new and existing pipelines in the event that holes or cracks appear. Such a lining material is typically applied to a thickness of between 1mm and 6mm in a single pass, although subsequent additional passes may be performed, depending on the circumstances. Of course, any other suitable sprayable lining material could be used.

Figure 5 shows the cured lining material 37 forming a continuous fluid-tight coating on the interior surfaces of the pipe sections 1 and 3 and the interior surface 17 of the gap spanning material 15.

The lining material 35 may be applied by a vehicle 19 in a similar manner to the gap spanning material 15 in Figure 3, or a different vehicle may be employed. It should be understood that the lining material 35 may be applied by any suitable spray coating method.

It can be seen from Figure 6 that the gap spanning material provides a substantially smooth, planar surface, which bridges the gap or discontinuity 13 between the pipe sections 1 and 3, which is substantially flush with the internal surface of the pipe

sections 1 and 3. This allows the successful application of the lining material 35 to form a fluid-tight liner 37.

The gap spanning method described may also be employed in bridging cracks or holes (for example, due to corrosion) formed in a pipeline, whether or not such a pipeline comprises a plurality of discrete sections. The gap spanning method may also be employed to seal off a fluid passage communicating with the main pipeline, where that fluid passage has become redundant.

CLAIMS

1. A method of lining a pipe having at least one gap or discontinuity in the interior surface thereof, the method including applying filling material to the gap or discontinuity, and spraying a lining material over an interior surface of the pipe and the filling material.

2. A method according to claim 1, wherein the pipe comprises a plurality of coupled sections and wherein the gap or discontinuity is formed at the region where respective adjacent sections are coupled.

3. A method according to claim 1, wherein the gap or discontinuity is created by deterioration of the pipe over time, such as by cracking or corrosion.

4. A method according to claim 1, wherein the gap or discontinuity is a redundant fluid passage.

5. A method of lining a pipe comprising a plurality of coupled sections, the sections being coupled such that a discontinuity in the interior surface of the pipe is formed at the region of the coupling, the method including:

applying a filling material to the region of the coupling to bridge the discontinuity and present a substantially smooth interior surface for the pipe, and

spraying a lining material over the interior surface of the pipe, including the region of the coupling.

6. A method of forming a pipe, including coupling a plurality of pipe sections, and lining the pipe according to the method of any one of the preceding claims.

7. A method according to claim 2, 5 or 6, wherein the pipe sections are coupled by a spigot and socket joint.

8. A method according to any one of the preceding claims, wherein the lining material forms a cross-linked molecular structure.

9. A method according to any one of the preceding claims, wherein the lining material is a flexible polyurea.

10. A method according to any one of claim 2 and 5 to 9, wherein a fluid seal is applied between the pipe sections.

11. A method according to claim 10, wherein the fluid seal is applied prior to lining the pipeline.

12. A method according to claim 10 or 11, wherein the fluid seal is applied prior to applying the filling material.

13. A method according to claim 10, 11 or 12, wherein the fluid seal is located further from the centre of the pipe than the filling material.

14. A method according to any one of the preceding claims, wherein the filling material is applied by spraying the filling material onto the interior surface of the pipe.

15. A method according to any one of claims 1 to 13, wherein the filling material is applied by forming a cavity at the gap or discontinuity and supplying filling material to the cavity.

16. A method according to claim 15, wherein the cavity is formed by an inflatable bladder inflated within the pipe.

17. Apparatus for lining a pipe having at least one gap or discontinuity therein, the apparatus comprising means for applying filling material to the gap or discontinuity, and means for spraying a lining material over an interior surface of the pipe and the filling material.

18. The method or apparatus substantially as hereinbefore described with reference to and/or substantially as illustrated in any one of or any combination of Figures 3, 4, 5 and 6 of the accompanying drawings.

ABSTRACT

LINING OF PIPES

Prior to the application of a spray coated lining material 35, a gap spanning material 15 is applied to the gap 13, for example, between two pipe sections 1 and 3 comprising a pipeline. The gap spanning compound 15 forms an interior surface 17 within the pipeline which is substantially flush with the interior surfaces of the pipe sections 1 and 3. Because the gap spanning material bridges the gap 13 between the pipe sections 1 and 3, the lining material 35 can be applied with increased reliability, with the risk of a gap in the formed liner 37 being present at the region of the gap 13 being reduced.

[Figure 5]

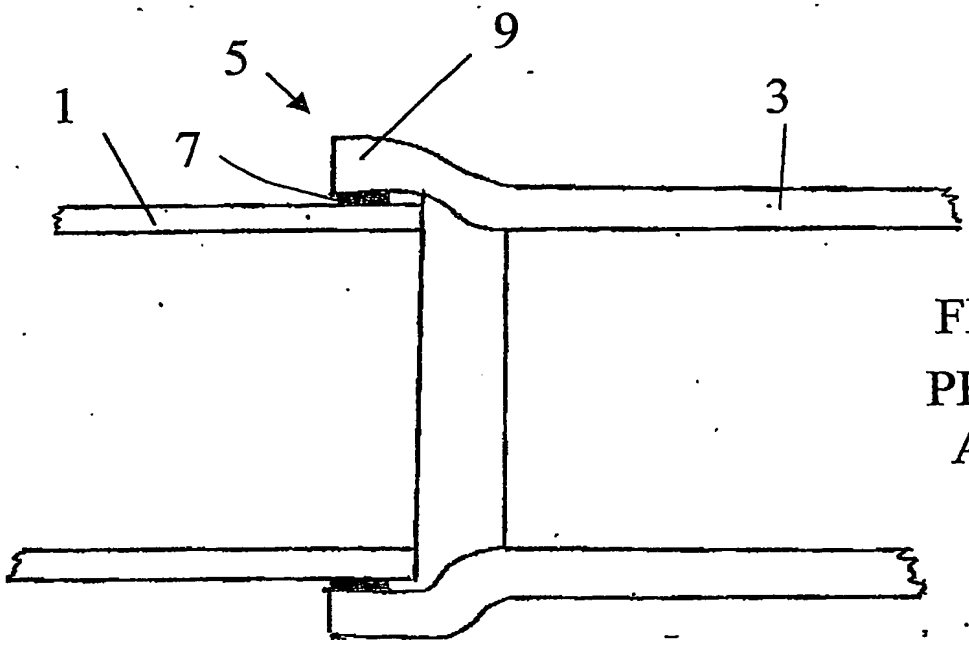

FIG. 1
PRIOR
ART

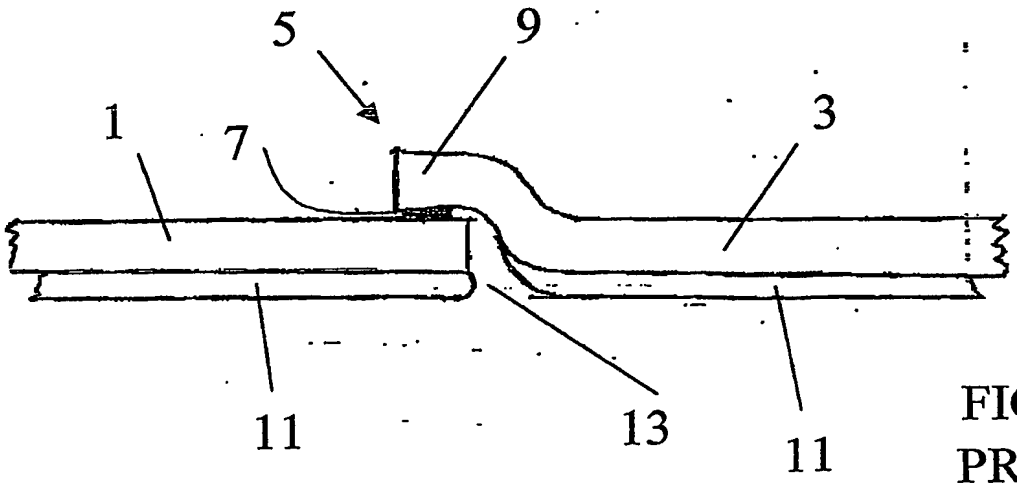

FIG. 2
PRIOR
ART

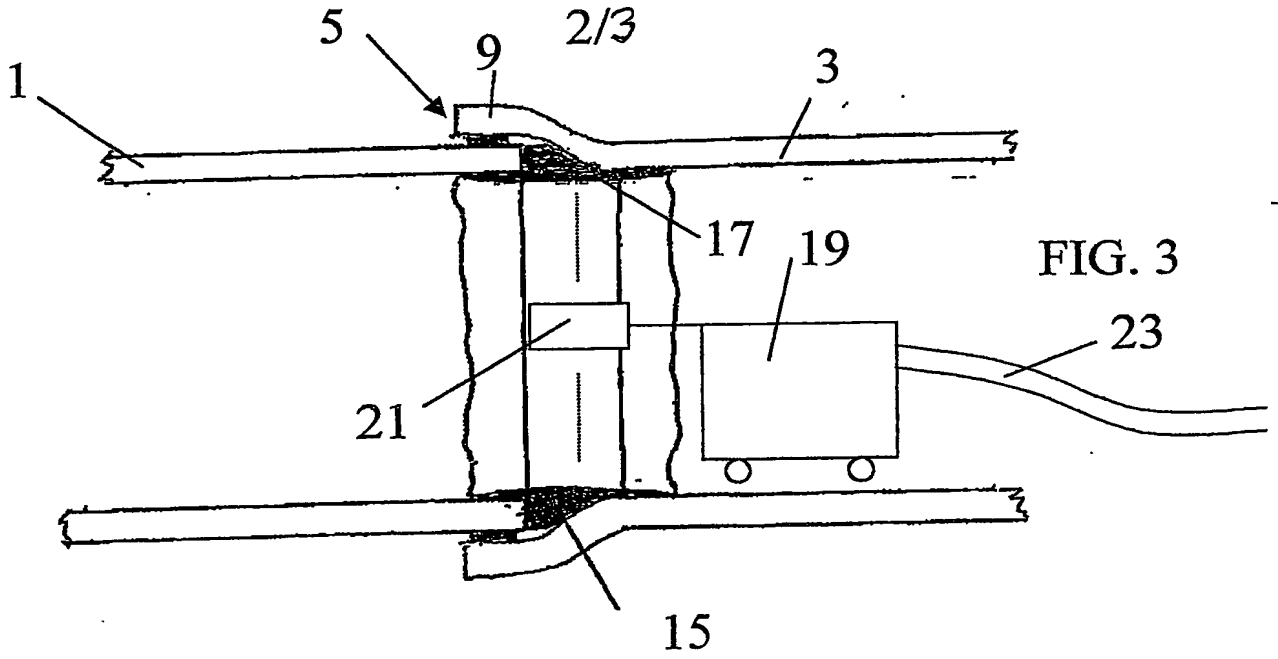

FIG. 3

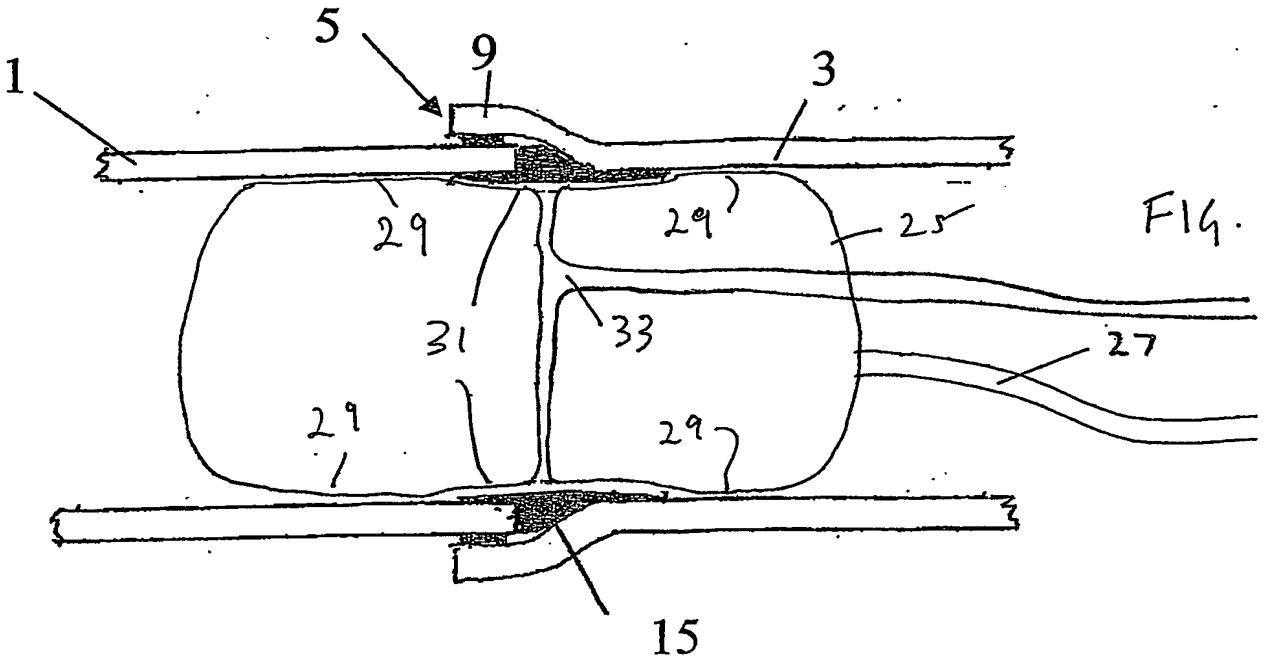

FIG. 4

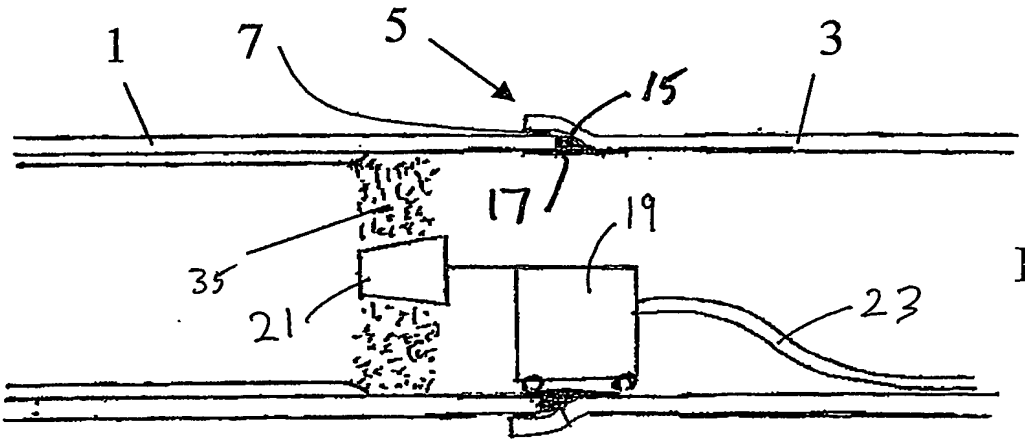

FIG. 5

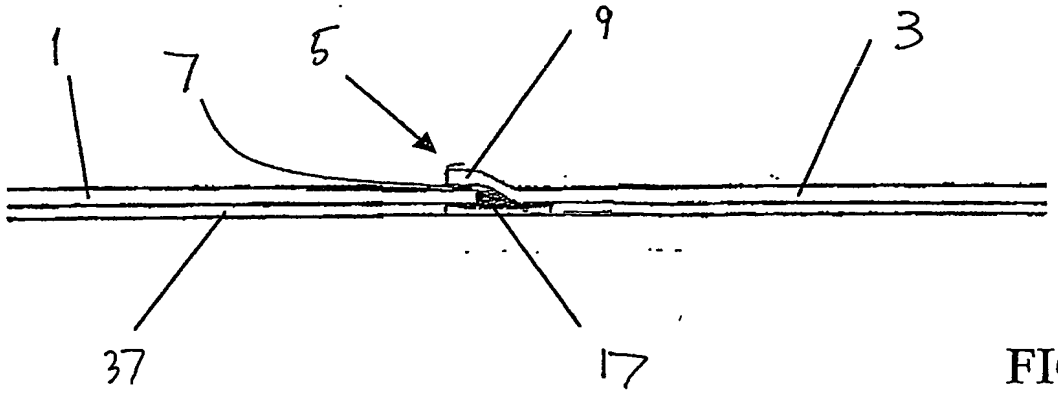

FIG. 6